



Mass vs. Weight

Stretching Mass

Objective

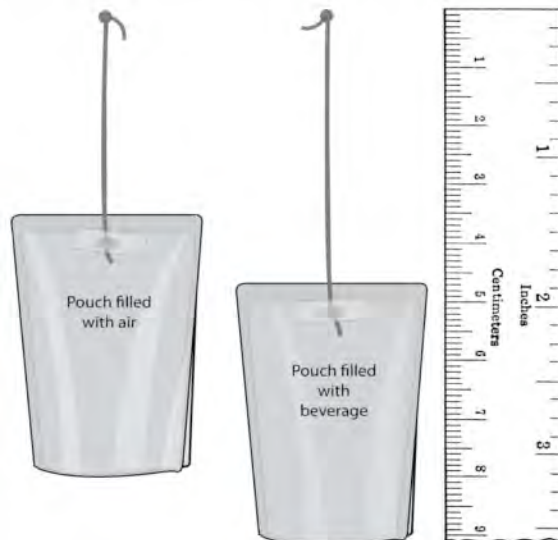
To investigate the difference between "mass" and "weight" in the normal gravity environment on Earth vs. the microgravity environment of space.

Description

Teams of two students each measure the force gravity exerts on objects of different mass by suspending them on elastic strings made from cut rubber bands and measuring the distance the band stretches. Students compare their results to that of a similar experiment done on the International Space Station (ISS) and discuss their conclusions.

Materials (per student team)

- Two size 19 rubber bands (common size found in classrooms)
- Full (liquid-filled) foil drink pouch (identical size)
- Empty (air-filled) foil drink pouch (identical size)
- Mass scale
- Scissors
- 30 cm ruler
- Cellophane tape (any classroom tape will work)
- Safety goggles
- Copies of the Student Data Sheets
- *Mass vs. Weight* "Stretching Mass" video clip



mass vs weight

Management

The rubber bands used in this activity should be cut to make straight elastic “strings”. Tie a knot at the same distance from each end of the string to create better grip for taping onto the drink pouch and for students to hold in their hands. Also, inflate the empty drink pouch by inserting the drink straw and blowing into it. Remove the straw and cover the hole with a piece of tape. Check each team to ensure their procedures are consistent.

Background

For background information, refer to the *Mass vs. Weight Introduction*.

Procedure

1. Lead a discussion of *gravity* and *microgravity* with the students before beginning this activity. Also discuss “*How can weight be measured in space?*” Be sure students ***practice safety, wear goggles and stay alert*** during this experiment.
2. Using a beam balance or digital scale, have students measure the masses of an empty (air-filled) drink pouch and a full (liquid-filled) drink pouch and record the measurements on Student Data Sheet 1.
3. Tape one end of the elastic string (rubber band) to the top of the air-filled drink pouch. Do the same for the liquid-filled drink pouch. Tape in same spot on each pouch.
4. Have one student hold the knot on the opposite end of the elastic string attached to the air-filled drink pouch and suspend vertically toward the floor. In the other hand, have the student do the same with the liquid-filled drink pouch.
5. Have the second student measure how much each drink pouch stretches the elastic string. Ensure the measurements are from the same points, preferably from their hand to the top of the drink pouch.
6. Have students record their measurements on the Data Sheets as they complete each part of the experiment.
7. When students have completed steps 1-6 on their data sheets, have them view the *Mass vs. Weight* “Stretching Mass” video clip. Have them record their conclusions based on the comparison of the normal gravity and microgravity outcomes of this experiment.

Assessment

1. Discuss the difference in the definitions of “mass” and “weight” and discuss the question, “*What is being measured by the stretch of the elastic string?*”
2. Students complete digital copies of the Data Sheets and share their answers as a class with teacher led discussions.

Extensions

1. Have students repeat the measurement steps by varying the mass of the empty pouch.
Have them cut a slot in the top of the pouch and insert pennies. Place pennies in the pouch in multiples of 10 (each penny has a mass of 2.5g) and measure how far 10, 20, 30, 40 and 50 pennies stretch the rubber band. Have the students design and construct a graph to plot their data.
2. Place an unknown quantity of pennies in the student’s pouches. Have them use their developed graphs to determine how many pennies are in the pouches based on the stretch of the elastic strings.
3. Use spring scales instead rubber bands to measure mass of each pouch.

Standards

National Science Education Standards

Unifying Concept and Processes

- Evidence, models, and explanation
- Change, constancy, and measurement

Science as Inquiry

- Abilities necessary to do scientific inquiry

Physical Science

- Motions and Forces

History and Nature of Science

- Science as a human endeavor

Principles and Standards for School Mathematics

(refer to *Mass vs. Weight* “Introduction” for complete standards)

Number and Operations

- Understand numbers
- Understand meanings
- Compute fluently

Measurement

- Understand measureable attributes
- Apply appropriate techniques

Data Analysis and Probability

- Formulate questions
- Develop and evaluate inferences
- Understand and apply

Process Standards

- Problem Solving
- Communication
- Connections
- Representation

Name: _____

Stretching Mass Student Data Sheet 1

**PRACTICE SAFETY – WEAR
GOGGLES – STAY ALERT**

1. Measure the mass (in grams) of both an empty (air-filled) drink pouch and a full (liquid-filled) drink pouch. Record your data below.

empty drink pouch = _____ g

full drink pouch = _____ g

2. Predict what will happen when you suspend an air-filled drink pouch attached to a rubber band held in your hand:

Predict what will happen when you suspend a liquid-filled drink pouch attached to a rubber band held in your hand:

Carefully cut a rubber band in one place to make an elastic string. Take an empty drink pouch (air-filled) and tape one end of the string to the top part of the pouch. Do the same for a full (liquid-filled) drink pouch. Hold the other end of each string in your hand and let the drink pouches suspend freely. Answer the questions below.

3. Have your partner measure how far (in centimeters), from your hand, the empty drink pouch stretches the string, and record your answer below. Mark your measurement on the ruler on Student Data Sheet 2:
4. Measure how far (in centimeters), from your hand, the full drink pouch stretched the string and record your answer below. Graph your measurement on the rulers on Student Data Sheet 2:

empty drink pouch = _____ cm

full drink pouch = _____ cm

difference = _____ cm

5. Describe what happened and explain the results from your experiment with the empty and full drink pouches: (use the back of the paper if needed)

6. Predict what will happen if astronauts did the same experiment onboard the International Space Station (ISS) in a microgravity environment. (use the back of the paper if needed)

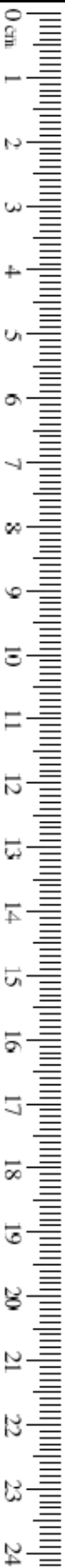
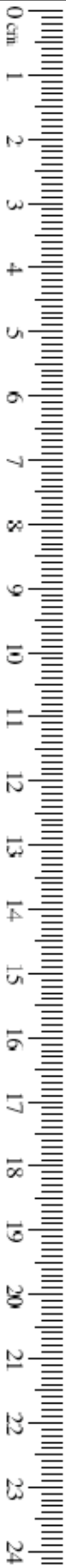
Name: _____

Stretching Mass
Student Data Sheet 2

Record your measurements from Student Data Sheet 1 questions 3 and 4 by shading in your measurements on the proper ruler. Observe the difference of each measurement.

EMPTY (air-filled)
DRINK POUCH

FULL (liquid-filled)
DRINK POUCH



DRAFT